Ian Virrels' (Shell Global Solutions) Comments Submitted by E-mail to DOE

Linda/Teresa,

Please find below information from Shell that was requested as a result of the DOE workshop. Please note that I will be out of the office from the 8th to the 18th of November, so if you have any additional questions during this time please address them to my colleague Richard Clark who will be in the UK and available on (+44 151 373 5613).

We are aware of the nature of the rulemaking process regarding these documents being publicly available. Where the information below is not Shell's (i.e. the internal memo from Caltrans - California Transport Authority), we have sought appropriate approval for its release to you for these purposes.

Should you have any comments or additional questions, please feel free to contact us.

General

* The following are our presentations from the last two DOE-sponsored DEER conferences that we've presented in the U.S.:

- The Performance of SMDS Diesel Fuel Manufactured by Shell's GTL Technology
  DEER2000 v4.pdf
- An Evaluation of Shell GTL Diesel – The Environmental Benefits
  DEER2002 v2.pdf

* Please find below, three of our most comprehensive SMDS publications at a key European conference:

- The Performance of Diesel Fuel Manufactured by the Shell Middle Distillate Synthesis Process
  Handout version of Es#44C2A.pdf

- The Performance of Diesel Fuel Manufactured by Shell's GTL Technology in the Latest Technology Vehicles
  Handout version of ES#44C29.pdf

- The Environmental Benefits of Shell GTL Diesel
  Handout version of Es#44C28.pdf

* Specific DOE interest in ULSD comparison - The Esslingen 2001 and DEER 2002 presentations specifically make comparisons against a UK ULSD of approx 30 ppm Sulphur.

* Fuel economy/power (cf. low density) - Esslingen 2003 paper indicates CO2, mass and volumetric fuelling effects. Papers in general indicate that there was no issue for SMDS fuelled vehicles to meet the proscribed test cycles.

* Hydrocarbon breakdown and full speciation of typical SMDS (e.g. n:i:cyclic, chain lengths) - At this time we cannot release any more data than we have in the above and open literature. We are looking into this, but unfortunately will not meet the deadline of the 15th. The key point is that as the aromatics are near undetectable, we are dealing with a pure paraffinic product. Furthermore, the indications are that cyclo-paraffins are very low as well.

Additional Data

* CEC (Gary Yowell) will be forwarding emissions data from work with Caltrans.

Energy Efficiency

* Request from DOE for additional information:

The ranges are 60-65% for thermal efficiency and 80-82% for carbon efficiency (note that: (1) these are stand-alone plant efficiencies; and (2) that these numbers are notional and can change as a consequence of gas composition and local conditions for specific projects. Also see our environmental brochure, attached below.

- Gas to Liquids: Shell Middle Distillate Synthesis and the Environment
  SMDS environmental brouchure#44C27.pdf

Health Effects

* Data that other parties have published - There are only presumed indications by the lower emissions, better eco-toxicity and biodegradability, in addition the fuel itself has close to zero aromatics. There are recent indications of lower PAH and air toxics from the three SAE papers below (criteria pollutants section). However Kittleson last month gave an SAE paper with Schaberg of SASOL (SAE2002-01-2727), indicating that FT fuels gives a smaller number in the nanoparticle range .

* Can Shell supply DOE the full data on the biodegradability and eco-toxicity (that was summarized in the DEER 2002 paper)? - Now available in detail in:

- The Environmental Benefits of Shell GTL Diesel
  Handout version of Es#44C28.pdf

Cold Flow

* Further details of the cold flow properties of SMDS-1 (the first generation plant material from Bintulu Malaysia)? - The first generation product from Bintulu (SMDS-1) is the material that we currently have. However, we have developed a second-generation catalyst that will be used in the future world scale plants that Shell has announced plans for. The Esslingen 2001 paper indicates that pilot plant samples of this.

SMDS-2 product have excellent cold flow performance: a CFPP of approximately -26 deg C (-15 deg F). The effect is to change the iso:n ratio slightly and the cetane falls from approx 81 to 77. However, bulk properties and emissions remain the same.

Non-Criteria Pollutants

* The below are recent SAE refs on PAH & air toxics:

[1] J.C Ball, C. Lapin, J. Buckingham, E. Frame, D. Yost, J. Garbak,, M.A. Gonzalez, E. Liney, M. Natarajan and J.P Wallace, "Dimethoxy methane in diesel fuel: Part 1.The effects of fuels and engine operating modes on emissions of toxic air pollutants and gas/solid phase PAH," SAE2001-01-3627.

[2] J.C Ball, C. Lapin; J. Buckingham, E. Frame, D. Yost, J. Garbak, M.A. Gonzalez, E. Liney, M. Natarajan and J.P Wallace. "Dimethoxy methane in diesel fuel: Part 2. The effects of fuels on emissions of toxic air pollutants and gas/solid phase PAH using a composite of engine operating modes," SAE 2001-01-3628.

[3] J.C Ball, C. Lapin, J. Buckingham, E. Frame, D. Yost, J. Garbak, M.A. Gonzalez, E. Liney, M. Natarajan and J.P Wallace "Dimethoxy methane in diesel fuel: Part 3. The effect of pilot injection, fuels and engine operating modes on emissions of toxic air pollutants and gas/solid phase PAH," SAE 2001-01-3630.

No Harms - Elastomers

* Work in conjunction with Caltrans Fleet - The attached internal memo details that during a month long trial we conducted in April 02 at the Caltrans depot in Stockton, the switch to the 100% GTL fuel (and then back to regular ULSD diesel) had no adverse effects. Furthermore, although the memo is dated June, this is still the case as of early November. It should be noted that the trial was conducted with no engine modifications and no audit or changing of any elatomers.

> "From April 12, 2002 through May 11, 2002 approximately 7,500 gallons of Gas To Liquid (GTL) diesel fuel was distributed from the Caltrans bulk fuel site in Stockton. During that period 69 different Caltrans units fueled at the Stockton site. The 69 units were comprised of 46 different Maintenance Classes ranging from 3/4 pickups to class 8 tractors along with various construction units. During the test period none of the units experienced fuel-related problems. Nor have we experienced fuel-related problems since converting back to Ultra Low Sulfur Diesel. "

I understand that Caltrans will be submitting comments to DOE.

- Memorandum: GTL Fuel Test
  Caltrans memo re- SMDS use.pdf

* NREL elastomer work, - Teresa Alleman is seeking approval from all of the parties participating in the trial with Yosemite waters regarding the release of this data

* We have in-house work on elastomers, which allows us to take appropriate action when introducing SMDS fuel and blends to the field. Unfortunately at this stage we cannot release these data.

Ian Virrels
Fuels Scientist
Shell Global Solutions (US) Inc.
Westhollow Technology Center
3333 Hwy. 6 S.
Houston, TX 77082-3101
United States of America
Tel: 281-544-8127
Fax: 281-544-7620
E-mail: ian.virrels@shell.com
Internet: www.shellglobalsolutions.com